Amendments of the Claims

This listing of claims will replace all prior versions and listings of claims in this application.

Listing of Claims

1. (Original) A method for modulating a refractive index of an ion insertion layer in an optical device, the ion insertion layer having a dielectric constant, the dielectric constant having a real portion and an imaginary portion, the method comprising:

providing an ion conduction layer adjacent the ion insertion layer; and

inserting ions from the ion conduction layer into the ion insertion layer;

wherein:

during the inserting, the imaginary portion of the dielectric constant changes from a first value to a second value and the real portion of the dielectric constant changes from a third value to a fourth value at the wavelength of interest or at the operational wavelength; and

the absolute value of the difference between the second value and the first value is less than the absolute value of the difference between the fourth value and the third value.

2. (Original) The method of claim 1 wherein the absolute value of the difference between the second value and the first value divided by the absolute value of the difference between the fourth value and the third value is less than 0.40.

3. (Original) The method of claim 1 wherein the ion insertion layer is vanadium pentoxide.

4. (Original) The method of claim 1 wherein the ion conduction layer comprises a metal oxide.

5. (Original) The method of claim 1 wherein the ion conduction layer comprises a metal oxide having lithium.

6. (Original) The method of claim 1 wherein the ion conduction layer is Li_2O-P_2O_5-A_bO_x, wherein A_bO_x is selected from the group consisting of WO_3, TiO_2, and Fe_2O_3.

7. (Original) The method of claim 1 further comprising:

providing an ion storage layer having a transmissivity, wherein the ion storage layer stores ions for transport across the ion conduction layer and into the ion insertion layer and wherein the transmissivity of the ion storage layer is not substantially changed.

8. (Original) The method of claim 7 wherein the ion storage layer is tin oxide.

9. (Original) The method of claim 7 further comprising providing a transparent electrically conductive oxide adjacent the ion storage layer.

10. (Original) The method of claim 1 wherein the ion insertion layer is vanadium pentoxide, the method further comprising:

emitting an optical signal having a wavelength in the range from about 0.8 microns to about 1.7 microns.

11. (Original) The method of claim 1 further comprising providing a transparent electrically conductive oxide adjacent the ion insertion layer.

12. (Original) The method of claim 1 further comprising providing a transparent electrically conductive oxide adjacent the ion conduction layer.

13. (Original) The method of claim 1 wherein the inserting further comprises applying an electric field across the ion insertion layer and the ion conduction layer.

14. (Original) The method of claim 1 further comprising:

extracting the ions from the ion insertion layer into the ion conduction layer, wherein:

during the extracting, the imaginary portion of the dielectric constant changes from a second value to a fifth value and the real portion of the dielectric constant changes from a fourth value to a sixth value at the wavelength of interest or at the operational wavelength;

the absolute value of the difference between the fifth value and the second value is less than 2% of the first value; and

the absolute value of the difference between the sixth value and the fourth value is less than 2% of the third value.

15. (Original) The method of claim 1 wherein the ion insertion layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

16. (Original) The method of claim 1 wherein the ion conduction layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

17. (Original) A method for modulating a refractive index of an ion insertion layer in an optical device, the ion insertion layer having a dielectric constant, the dielectric constant having a real portion and an imaginary portion, the method comprising:

providing an ion conduction layer adjacent the ion insertion layer;

inserting ions from the ion conduction layer into the ion insertion layer; and

extracting the ions from the ion insertion layer into the ion conduction layer;

wherein:

during the inserting, the imaginary portion of the dielectric constant changes from a first value to a second value and the real portion of the dielectric constant changes from a third value to a fourth value;

the absolute value of the difference between the second value and the first value is less than the absolute value of the difference between the fourth value and the third value;

during the extracting, the imaginary portion of the dielectric constant changes from a second value to a fifth value and the real portion of the dielectric constant changes from a fourth value to a sixth value;

the absolute value of the difference between the fifth value and the second value is less than 2% of the first value; and

the absolute value of the difference between the sixth value and the fourth value is less than 2% of the third value.

18. (Original) The method of claim 17 wherein the ion insertion layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

19. (Original) The method of claim 17 wherein the ion conduction layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

20. (Currently Amended) A method for modulating a refractive index of an ion insertion layer in an optical device, the refractive index having a real portion and an imaginary portion, the method comprising:

providing an ion conduction layer adjacent the ion insertion layer;

inserting ions from the ion conduction layer to the ion insertion layer; and

wherein:

during the inserting, the real portion changes from a first value to a second value and

the imaginary portion changes from a third value to a fourth value;

the difference between the second value and the first value is greater than 0.1; and

the difference between the fourth value and the third value is less than 0.2.

21. (Original) The method of claim 20 wherein the ion insertion layer is vanadium pentoxide.

22. (Original) The method of claim 20 wherein the ion conduction layer comprises a metal oxide.

23. (Original) The method of claim 20 wherein the ion conduction layer comprises a metal oxide having lithium.

24. (Original) The method of claim 20 wherein the ion conduction layer is $Li_2O-P_2O_5-A_bO_x$, wherein A_bO_x is selected from the group consisting of WO_3, TiO_2, and Fe_2O_3.

25. (Original) The method of claim 20 further comprising:

providing an ion storage layer having a transmissivity, wherein the ion storage layer stores ions for transport across the ion conduction layer and into the ion insertion layer and wherein the transmissivity of the ion storage layer is not substantially changed.

26. (Original) The method of claim 25 wherein the ion storage layer is tin oxide.

27. (Original) The method of claim 20 further comprising providing a transparent conductive oxide adjacent the ion storage layer.

28. (Original) The method of claim 20 wherein the ion insertion layer is vanadium pentoxide, the method

further comprising:

emitting an optical signal having a wavelength in the range from about 0.8 microns to about 1.7 microns.

29. (Original) The method of claim 20 further comprising providing a transparent conductive oxide adjacent the ion insertion layer.

30. (Original) The method of claim 20 further comprising providing a transparent conductive oxide adjacent the ion conduction layer.

31. (Original) The method of claim 20 wherein the inserting further comprises applying an electric field across the ion insertion layer and the ion conduction layer.

32. (Original) The method of claim 20 further comprising extracting the ions from the ion insertion layer into the ion conduction layer.

33. (Original) The method of claim 20 wherein the ion insertion layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

34. (Original) The method of claim 20 wherein the ion conduction layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel

deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

35-38. (Withdrawn)

39. (Currently Amended) An iono-refractive device comprising:

an ion conduction material; and

an ion insertion material adjacent the ion conduction material, the ion insertion material having a refractive index, the refractive index having a real portion and an imaginary portion;

wherein:

upon insertion of ions from the ion conduction layer into the ion insertion layer, the ~~real~~ imaginary portion of the refractive index changes from a first value to a second value and the real portion of the ~~dielectric constant~~ refractive index changes from a third value to a fourth value; and

the absolute value of the difference between the second value and the first value is less than the absolute value of the difference between the fourth value and the third value.

40. (Original) The device of claim 39 wherein the ion insertion layer is vanadium pentoxide.

41. (Original) The device of claim 39 wherein the ion conduction layer comprises a metal oxide.

42. (Original) The device of claim 39 wherein the ion conduction layer comprises a metal oxide having lithium.

43. (Original) The device of claim 39 wherein the ion conduction layer is $Li_2O-P_2O_5-A_bO_x$, wherein A_bO_x is selected from the group consisting of WO_3, TiO_2, and Fe_2O_3.

44. (Original) The device of claim 39 further comprising an ion storage layer.

45. (Original) The device of claim 44 wherein the ion storage layer is tin oxide.

46. (Original) The device of claim 44 further comprising a transparent conductive oxide layer adjacent the ion storage layer.

47. (Original) The device of claim 39 further comprising a transparent conductive oxide layer adjacent the ion conduction layer.

48. (Original) The device of claim 39 further comprising a transparent conductive oxide layer adjacent the ion insertion layer.

49. (Original) An iono-refractive device comprising:

an ion conduction material; and

an ion insertion material adjacent the ion conduction material, the ion insertion material having a refractive index, the refractive index having a real portion and an imaginary portion;

wherein upon insertion of ions from the ion conduction layer into the ion insertion layer, the real portion of the refractive index changes by more than about 0.1 and the imaginary portion of the refractive index changes by less than about 0.2.

50. (Original) The device of claim 49 wherein the ion insertion layer is vanadium pentoxide.

51. (Original) The device of claim 49 wherein the ion conduction layer comprises a metal oxide.

52. (Original) The device of claim 49 wherein the ion conduction layer comprises a metal oxide having lithium.

53. (Original) The device of claim 49 wherein the ion conduction layer is Li_2O-P_2O_5-A_bO_x, wherein A_bO_x is selected from the group consisting of WO_3, TiO_2, and Fe_2O_3.

54. (Original) The device of claim 49 further comprising an ion storage layer.

55. (Original) The device of claim 54 wherein the ion storage layer is tin oxide.

56. (Original) The device of claim 54 further comprising a transparent conductive oxide layer adjacent the ion storage layer.

57. (Original) The device of claim 49 further comprising a transparent conductive oxide layer adjacent the ion conduction layer.

58. (Original) The device of claim 49 further comprising a transparent conductive oxide layer adjacent the ion insertion layer.

59. (Withdrawn)

60. (Withdrawn)

61. (Original) An apparatus for modulating a refractive index of an ion insertion layer in an optical device, the ion insertion layer having a dielectric constant, the dielectric constant having a real portion and an imaginary portion, the apparatus comprising:

means for providing an ion conduction layer adjacent the ion insertion layer; and

means for inserting ions from the ion

conduction layer into the ion insertion layer;
wherein:

during the inserting, the imaginary portion of the dielectric constant changes from a first value to a second value and the real portion of the dielectric constant changes from a third value to a fourth value at the wavelength of interest or at the operational wavelength; and

the absolute value of the difference between the second value and the first value is less than the absolute value of the difference between the fourth value and the third value.

62. (Original) The apparatus of claim 61 wherein the ion insertion layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

63. (Original) The apparatus of claim 61 wherein the ion conduction layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

64. (Original) An apparatus for modulating a refractive index of an ion insertion layer in an optical device, the refractive index having a real portion and an imaginary portion, the apparatus comprising:

means for providing an ion conduction

layer adjacent the ion insertion layer; and

means for inserting ions from the ion conduction layer to the ion insertion layer;

wherein:

during the inserting, the real portion changes from a first value to a second value and the imaginary portion changes from a third value to a fourth value;

the absolute value of the difference between the second value and the first value is greater than 0.1; and

the absolute value difference between the fourth value and the third value is less than 0.2.

65. (Currently Amended) The apparatus of claim 64 wherein the ion ~~conduction~~ insertion layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

66. (Original) The apparatus of claim 64 wherein the ion conduction layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

67-69. (Withdrawn)

70. (Original) A method for modulating a refractive index of an ion insertion layer in an optical device, the refractive index having a real portion and an imaginary portion, the method comprising:

providing the ion insertion layer that is weakly electrochromic;

providing an ion conduction layer adjacent the ion insertion layer; and

inserting ions from the ion conduction layer into the ion insertion layer;

wherein:

during the inserting, the real portion changes from a first value to a second value and the imaginary portion changes from a third value to a fourth value;

the absolute value of the difference between the second value and the first value is greater than 0.1; and

the absolute value of the difference between the fourth value and the third value is less than 0.2.

71. (Original) The method of claim 70 wherein the ion insertion layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

72. (Original) The method of claim 70 wherein the ion conduction layer is formed by a process, wherein the process is selected from the group consisting of

thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

73. (Original) A method for modulating a refractive index of an ion insertion layer in an optical device, the ion insertion layer having a lattice structure, the refractive index having a real portion and an imaginary portion, the method comprising:

providing an ion conduction layer adjacent the ion insertion layer; and

inserting ions from the ion conduction layer into the ion insertion layer;

wherein:

during the inserting, the lattice structure of the ion insertion layer changes and the real portion changes from a first value to a second value and the imaginary portion changes from a third value to a fourth value;

the absolute value of the difference between the second value and the first value is greater than 0.1; and

the absolute value of the difference between the fourth value and the third value is substantially diminished in response to changing the lattice structure.

74. (Original) The method of claim 73 wherein the ion insertion layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel

deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

75. (Original) The method of claim 73 wherein the ion conduction layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

76. (Original) A method for modulating a refractive index of an ion insertion layer in an optical device, the refractive index having a real portion and an imaginary portion, the method comprising:

providing an ion conduction layer adjacent the ion insertion layer;

annealing the ion insertion layer in an oxygen atmosphere; and

inserting the ions from the ion conduction layer into the ion insertion layer;

wherein:

during the inserting, the real portion changes from a first value to a second value and the imaginary portion changes from a third value to a fourth value;

the absolute value of the difference between the second value and the first value is greater than 0.1; and

the absolute value of the difference between the fourth value and the third value is substantially diminished in response to annealing the ion insertion layer.

77. (Original) The method of claim 76 wherein the ion insertion layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

78. (Original) The method of claim 76 wherein the ion conduction layer is formed by a process, wherein the process is selected from the group consisting of thermal evaporation, electron beam evaporation, chemical vapor deposition, plasma enhanced chemical vapor deposition, magnetron sputtering, ion sputtering, sol-gel deposition, co-deposition with polymeric or transition metal oxide materials, and deposition from a melt.

79-100. (Withdrawn)